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Adaptation of Foreign Students to Sharply Continental Climate of the Volgograd Region

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Abstract. This article is about the adaptative reactions of the cardiovascular system of foreign students from the warm countries to the sharp continental climate of the Volgograd region. The research includes the assessment of anthropometrical data of physical development, parameters of hemodynamics in the conditions of operational rest and the state of functional test (active orthostatic test). A foreign students insufficiency of physical development, deficiency of body mass is noted. Amongst them, persons with asthenic type of constitution prevail. In a condition of operational rest, a foreign students increase in systolic blood pressure and decrease coefficient of endurance of cardiovascular system which confirms work of a myocardium in tension mode is revealed. In the state of orthostatic test, multidirectional changes of systolic blood pressure, increase in diastolic blood pressure and sharp decrease in pulse pressure were noted indicating tension and instability of cardiovascular system activity. Functional adaptation of foreign students to climate-geographical factors of the Volgograd region is complicated by influence of complex social factors which are connected with new living conditions and increase in educational activity in the university.

1. Introduction

The problem of education and training of experts for foreign countries is a relevant and important component of the foreign economic and foreign policy activity of the Russian federation. The development strategy of the Volgograd state technical university is focused on the training of highly qualified specialists, including, foreign students within the international cooperation. From year to year, the number of foreign students who come to study in the universities of the Volgograd region increases. At the same time the problem of successful adaptation of foreign students depends on which their social, physical and mental health and remains the center of attention of many Russian and foreign scientists.

The climate of the Volgograd region is arid with sharply expressed continentality according to the report of the Natural Resources and Ecology committee. The average temperature in January is from -8 °C to -12 °C, July from +23 °C to +25 °C, a maximum absolute temperature of +42 to +44 °C is observed usually from July to August and a minimum absolute temperature of -36 to -42 °C is observed from January to February.

Man is a part of nature, and he is affected by all factors of the environment – gravitation, atmospheric pressure, air temperature, illumination, radiation [1, 3, 10]. Changes in the environment are followed



by functional reorganizations in a human body. Homeostasis is established at a new level and conforms to new requirements under specific environmental conditions, that is physiological (functional) adaptation [2, 6, 12, 13].

Adapting, the organism is reconstructed, his metabolism changes. In this aspect the leading role is assigned to mechanisms of temperature homeostasis keeping conditions of optimum performance of life-supporting systems. Maintenance of thermal balance is closely connected with activity of cardiovascular system which provides both humoral and reflex ways of thermal control [8, 10, 11, 15]. Functional adaptation of foreign students to climate-geographical factors of the Volgograd region is complicated by influence of complex social factors which are connected with new living conditions and increase in educational activity in the university [9, 13]. They are forced to adapt to increasing tension and activity of the regulatory systems. In that case, optimization of the adaptation processes happens where the coordination of the body systems and organs of the individual corresponds with surrounding natural and social conditions [2, 4, 7].

Training in a higher educational institute is a difficult enduring process. Mental and physiological characteristics of students depend on the specificity of educational activity (training methods, control of knowledge, examinations). During the entire period of training, students are in constant intellectual tension causing hyperactivity of functional life-supporting systems.

The fact that these students carry out educational activities in a foreign-language environment complicates the process of adaptation and the choice of her optimum strategy. The impossibility of fast adaptation to study and communicate in Russian leads to decrease in motivation for achievement. The language barrier appears to be the main obstacle for effective inclusion into the new socio-cultural environment with the learning of cultural traditions and microsocio norms [13].

These students are forced to adapt to a complex of new factors to receipt in any higher institution of Russia. The intensification of physiological processes is caused by new climate-geographical conditions of accommodation, a diet, constantly occurring environmental pollution, acceleration of speed and a rhythm of life. Under the influence of external irritants their morphological and behavioral characteristics changes for the purpose of maintaining balance with the environment.

Thus, the process of adaptation for foreign students becomes complicated by following factors: 1) adaptation to new climatic conditions; 2) systematical adaptation for adequate functioning of the body; 3) overcoming a language barrier and active inclusion in educational process.

2. Materials and methods

Foreign students from South and Southwest Asian countries, the Middle East and Africa have participated in research on a voluntary basis (58 people; age 21.8 ± 0.5 years). The students were informed to carry out research with the use of physiological techniques, they were assured about guarantee of nondisclosure of the obtained personal information. As a control group of comparison, the Russian students have been chosen (72 people; age 19.8 ± 0.7 years). The research included assessment of physical development and anthropometrical data with the use of standard indicators, registration of hemodynamics parameters in the conditions of operational rest and state of functional test.

As functional test, orthostatic load which consisted in change of position of a body upon transition from horizontal to vertical position was used. Body temperature was measured prior daily occupation at 9:00 am within 3 minutes in the left axillary using the mercury thermometer. The main research was conducted in the first half of day indoors with optimum conditions of a microclimate.

Statistical data analysis was carried out by means of "SPSS 17". Results are presented in form: $M \pm m$, where M – the arithmetic mean, m – arithmetic mean error. Statistical significant level of distinctions was accepted at the level $p \leq 0.05$.

3. Results and discussion

The average value of body temperature (t) of the group of foreign students was 36.2 ± 0.09 °C and had no significant distinctions in comparison with the body temperature of the Russian students (fig. 1)

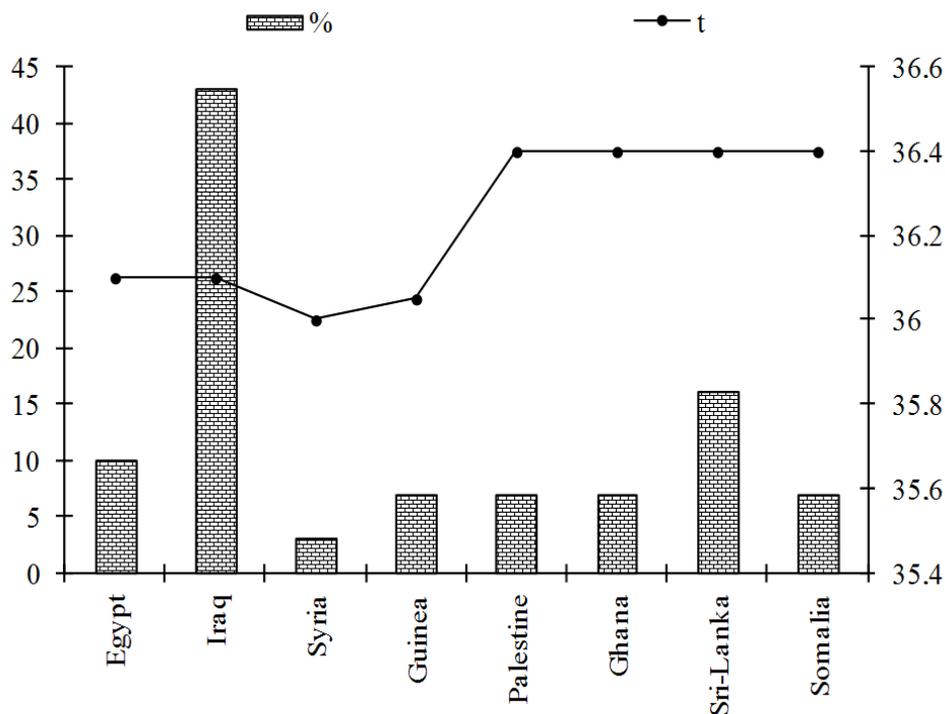


Figure 1. Average body temperatures (t) and a percentage ratio of the foreign students who have participated in a research

Genetical determination of body size is a variable parameter of physical health. Harmonious development of body and the ratio of the calculated indexes reflect intensity of exchange processes in an organism in response to influence of external factors [5, 14].

The comparative analysis of anthropometrical data has established distinctions of physical development of foreign and Russian students (tab. 1).

Table 1. Anthropometrical data in groups of the Russian and foreign students.

Parameters	Groups of students	
	Russian students	Foreign students
Age	20.1±0.6	21.2±0.9
Growth, cm	181.2±2.9	179.8±2.46
Body mass, kg	72.6±3.96	66.4±4.73
Index of body mass, c.u.	22.4±1.19**	20.1±1.27**
Erisman index, c.u.	4.01±1.5	3.2±1.6**
Pinye index, c.u.	14.3±6.5	25.4±7.04

** – distinction in comparison with physiological norm

Erisman index characterized by proportionality of development of a thorax and its deviation from age norm testifies to insufficiency of physical development, especially in group of foreign students (3.2 ± 1.6 c.u.). In the group of foreign students, a deficiency of body mass is noted compared to Russian students (Pinye index: 25.4 ± 7.04 , c.u.). At the same time the degree of variability of data (dispersion) according to Erisman and Pinye indexes in both groups testifies to intra-group

heterogeneity with the prevailing type being asthenic in foreign students and normostenic in Russian students (fig. 2).

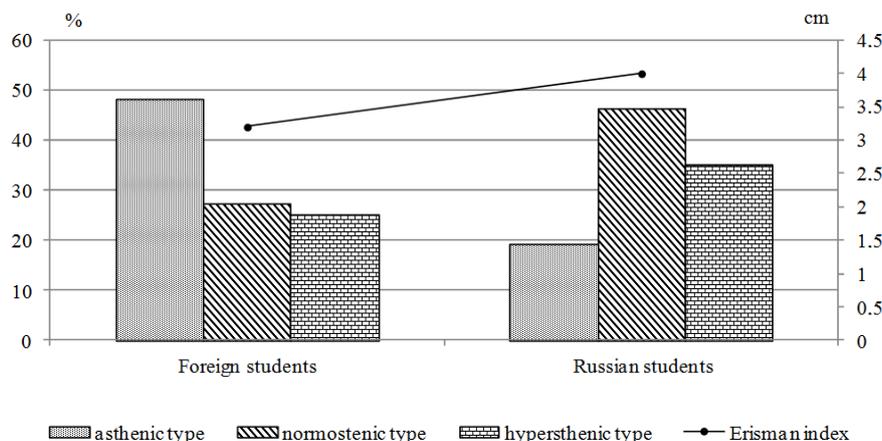


Figure 2. Ratio of types of physical development and proportionality of development of a thorax (Erisman index) in groups of foreign and Russian students.

The analysis of features of the haemodynamic system in the condition of operational rest showed that the rate of heartbeat was significantly higher in group of foreign students in comparison with the Russian students ($p < 0.05$) (tab. 2).

Table 2. Parameters of the hemodynamic system in groups of the Russian and foreign students in the condition of operational rest

Parameters	Groups of students	
	Russian students	Foreign students
Heartbeat rate blows/min.	68.2±1.22	78.5±3.01*
Systolic blood pressure of mm Hg	115.5±2.13	132.3±3.6*
Diastolic blood pressure of mm Hg	65.0±1.73	82.3±3.33*
Pulse pressure of mm Hg	45.0±1.95	44.8±4.3
Coefficient of cardiovascular system endurance, c.u.	14.0±0.54	12.7±1.2**

* – significant distinction of indicators in comparison with group of the Russian students;

** – distinction in comparison with physiological norm

The increased systolic blood pressure in foreign students compared to that of Russian students demonstrates the work of a myocardium in tension mode. The coefficient of cardiovascular system endurance (12.7±1.2 c.u.) which is lower in comparison with age norm in the group of foreign students also demonstrates this. The indicator which characterizes endurance and possibilities of cardiovascular system when comparing with standard data indicates prevalence of sympathetic orientation of a neurovegetative tone, tension of regulatory mechanisms, decrease in endurance and deterioration in functionality of cardiovascular system in foreign students. The deviation of coefficient of cardiovascular system endurance in foreign students from norm is observed by 24.8%.

For the assessment of the ability of the cardiovascular system to counteract negative impact of various factors of the environment we used orthostatic test.

As quantitative criteria has been chosen the shift coefficient on loading (CI) which allows the registration of adaptive reactions and orientation of changes of the studied parameters (fig. 3):

$$CI = \ln (P_n/P_f), \text{ where}$$

CI – shift coefficient on loading;

\ln – a natural logarithm;
 P_n – the parameter received under the influence of loading;
 P_f – state parameter

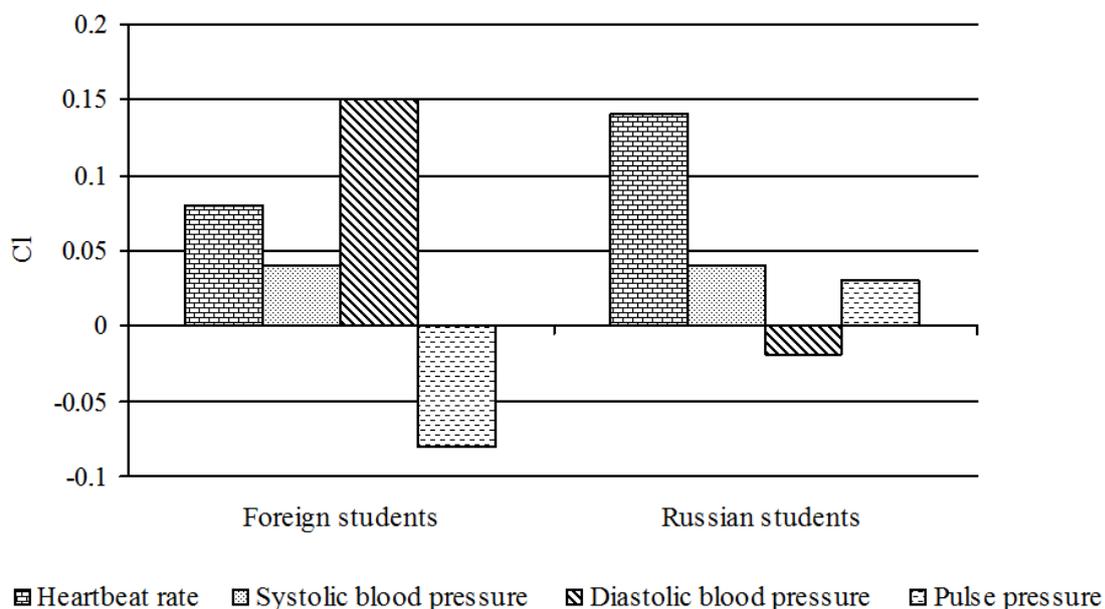


Figure 3. The coefficient of shift of reactions of the cardiovascular system against the state of active orthostatic test in groups of foreign and Russian students

In foreign students the most adverse reactions to orthostatic test were registered. Against the state of initially increased systolic pressure, multidirectional changes of this indicator in response to gravitational loading were noted (decrease in parameter in 15% of cases; increase in parameter in 35% of cases). At the same time increase in diastolic pressure was registered that in turn led to sharp decrease in pulse pressure. All this indicates tension of regulatory mechanisms and instability of processes of activity of cardiovascular system. Increase in systolic pressure indicates development of inadequate reaction, about violation of vegetative providing inactivity of cardiovascular system.

In the Russian students, the adequate reaction of cardiovascular system in response to gravitational changes of position of a body has been registered. The obtained data coincide with experimental data in scientific literature. Shifts of pulse (in our case heartbeat rate has increased for 11.1 blows/min.) and systolic blood pressure (increase on 8.3 mm Hg) are proportional characters and demonstrate good adaptability of cardiovascular system to gravitational loading. At the same time diastolic blood pressure has decreased by 4.8 mm Hg, which has led to increase in pulse pressure in group of the Russian students.

Urgent reaction of cardiovascular system in the group of the Russian students against the state of active orthostatic test was characterized by increase in rate heartbeat ($Cl = 0.143$ c.u.), increase in systolic blood pressure ($Cl = 0.044$ c.u.), insignificant decrease in diastolic blood pressure ($Cl = -0.023$ c.u.) and as a result increase in pulse pressure ($Cl = 0.039$ c.u.).

Increase in the pulse pressure which is indirectly characterized by increase in volume of blood in a heart systole, increase in the systolic blood pressure reflecting strengthening of a systole of the left ventricle (inotropic effect), and decrease in diastolic blood pressure (reduction of a tone arterioles – a vasodilatation), provides the best access of blood to the periphery.

4. Conclusions

The functional condition of the hemodynamic system is in many respects predetermined by the activity of the cardiovascular system and reflects adaptive possibility of an organism under changed conditions (e.g. changed environment conditions).

The registered unfavorable reactions of cardiovascular system in foreign students in the course of urgent adaptation to the changed climate-geographical factors of the environment (sharply continental climate of the Volgograd region) demonstrate instability of the processes of adaptation and tension of regulatory systems mechanisms.

Data of the structurally and functional changes of cardiovascular system in foreign students are of special interest. The vertical position of the electric axis of the heart which was noted in 52.5% of cases in foreign students correlates with indicators of their physical development caused by astenisation processes. In foreign students with high growth level, body mass deficiency was noted.

Increase in speed of metabolic processes in the organs of foreign students, perhaps, is caused by the processes of thermoregulation under cold conditions of sharply continental climate of the Volgograd region. Foreign students before enrolling into a higher educational institution, study in pre-university training faculty. Most of them come to Volgograd during the cold period of the year (November 2017 – January 2018).

The tropical and subtropical climate is replaced with a cold sharp continental climate of the Volgograd region with a small amount of snow. The organism of students is forced to adapt to this new climatic condition. The functional condition of life-supporting systems changes and reconstructs according to the new environmental conditions.

Thus, the obtained data confirm possible complications in the processes of adaptation and acclimatization of an organism of foreign students. Unsatisfactory adaptation exerts health impacts on these students and as a result, on their educational activity. Constant control of the state of health of these students on the basis of monitoring the parameters of physical development and cardiovascular system under the change temperature condition of environment is necessary.

Due to the established deficiency of body mass in most foreign students, the consulting help on questions of healthy nutrition is necessary.

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References

- [1] Agadzhanyan N.A., Makarova I.I. Ethnic aspect of adaptative physiology and population morbidity //Human Ecology. 2014. № 3. P. 3-13 (https://elibrary.ru/download/elibrary_21309472_67015969.pdf)
- [2] Agadzhanyan N.A., Batotsyrenova T.E., Severin A.E. et al. Comparison of specific features of the heart rate variability in students living in regions with different natural and climatic conditions //Human Physiology. 2007. V. 33. № 6. P. 66-70 (https://elibrary.ru/download/elibrary_9562640_61314065.pdf)
- [3] Averyanova I.V., Maximov A.L., Vdovenko S.I. Morphofunctional changes in long-time adaptation process observed in natives of intercontinental areas of Russia's northeast //Human Ecology. 2015. № 3. P. 12-19 (https://elibrary.ru/download/elibrary_23138342_80891702.pdf).
- [4] Charkoudian N. Skin Blood Flow in Adult Human Thermoregulation: How it works, when it does not, and why. //Mayo Clinic Proceedings. 2003. V.78(5). P. 603-12 (DOI: 10.4065 / 78.5.603).
- [5] Gagnon D., Jay O., Lemire B., Kenny G.P. Sex-Related Differences in Evaporative Heat Loss: The Importance of Metabolic Heat Production //European Journal of Applied Physiology. 2008. V. 104 (5). P. 821-29 (DOI: 10.1007/s00421-008-0837-0)
- [6] Garami A., Szekely M. Body temperature. Its regulation in framework of energy balance //Temperature. 2014. V.1. P.28-29 (DOI: 10.4161/temp.29060)

- [7] Govyazina T.N., Utochkin Yu.A. Assessment of basic behavioural risks concerning health of students attending medical university //Health Risk Analysis. 2017. №1. P. 84-90. (DOI: 10.21668/health.risk/2017.1.09.eng)
- [8] Kaciuba-Uscilko H., Grucza R. Gender Differences in Thermoregulation //Current Opinion in Clinical Nutrition and Metabolic Care. 2001. V. 4(6). P. 533-36 (DOI: 10.1097 / 00075197-200111000-00012)
- [9] Lila N. L., Tananakina T.P. Prognostic model of the functional body state in students //Herald of TVGU. Series: Biology and Ecology. 2015. № 1. P. 35-44 (https://elibrary.ru/download/elibrary_23454297_20278756.pdf)
- [10] Maslov L. N., Vychuzhanova E. A. Influence of long-term adaptation to cold on the state of cardiovascular system //Russian Journal of physiology. 2013. V. 99 (10). P. 1113-24 (https://elibrary.ru/download/elibrary_20379600_83039529.pdf)
- [11] Pettit S.E., Marchand I., Graham T. Gender Differences in Cardiovascular and Catecholamine Responses to Cold-Air Exposure at Rest //Canadian Journal of Applied Physiology. 1999. V. 24(2). P. 131-47 (DOI: 10.1139/h99-011)
- [12] Rostovtseva M. V., Shaydurova O. V., Gonchrevich N. A., Kovalevich I. A., Kudashov V. I. Level of capacity among undergraduate students //Novosibirsk State Pedagogical University Bulletin. 2018. V. 8(2). P 43-61 (DOI: 10.15293/2226-3365.1802.03)
- [13] Sevriukova G.A. Adaptive functional changes and working capacity of students during a learning process //Hygiene and sanitation. 2006. № 1. P. 72-73 (<https://elibrary.ru/item.asp?id=9172996>)
- [14] Szekely M., Szelenyi Z. Regulation of energy balance by peptides: A review //Current protein & peptide science. 2005. V. 6(4). P. 327-53 (DOI: 10.2174/1389203054546343)
- [15] Tikuisis P., Jacobs I., Moroz D., Vallerand A.L., Martineau L. Comparison of Thermoregulatory Responses Between Men and Women Immersed in Cold Water //Journal of Applied Physiology. 2000. V. 89(4). P. 1403-11 (PubMed: 11007575)